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# DETERMINANTS OF EXCHANGE RATES IN SOMALIA

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***ABSTRACT***

The purpose of this paper is to investigate the factors that determine exchange rates in Somalia and how those factors influence the exchange rates. To examine the relationship, a Monetary Approach to Exchange rate is employed to estimate the effects of trade balance, money supply, external debt and lack of government on exchange rate in Somalia for the period from 1970 to 2014 using MRA under OLS method. Main findings indicate that trade balance, money supply and external debt has a negative significant relationship to exchange rate in Somalia while lack of Government has a positive relationship to exchange rate. Also, this study examined some variables. Exchange rates also may be affected by some other factors that have not been considered in this study, so that this study recommends that central bank of Somalia should enact policies that improve the political factors it contributes towards gaining value of the Somalia shilling. This study adds lack of government to Monetary Approach Model, which has not been found in the scholarly literature.

**Contribution/ Originality:** This study is one of very few studies which have investigated in Somali from 1970 to 2014. The study applied monetary approach model under Ordinary least square method. The main findings are consistent with previous studies on this subject.

## 1. INTRODUCTION

The determination of exchange rates is one of the most commonly researched areas in Muço *et al.* (2004) the behavior of exchange rate is one of the unsettled issue of economic and finance related researches. Due to the enormous significance of the exchange rate in an economy, no one can deny the meaning to know the foreign exchange rate market behavior. So it is very important to study about the determinants of exchange rate as well as foreign exchange market behavior in details (Uddin *et al.*, 2013).

There are two main schools when the thoughts of fundamentals that address the concern of exchange rate forecasting and determination. One school of thought is the analysis that it is the demand and supply of currencies with flow idea that determine the equilibrium value of currencies. The utilize balance of payment information to

determine the demand and supply of currencies. Whereas the second school of thought is the analysis that equilibrium value of relative stock of financial assets determines the behavior of exchange rate (Saeed *et al*., 2012).

In African countries, exchange rate hurts the economic growth, in export since a significant portion of the costs of production is paid in domestic currency so that exchange rate results in a reduction of domestic currency and capacity of exporters to struggle in foreign markets. This chokes foreign exchange receipts and damages a country's capacity to buy the imports needed for economic activity (Shatz and David, 1996).

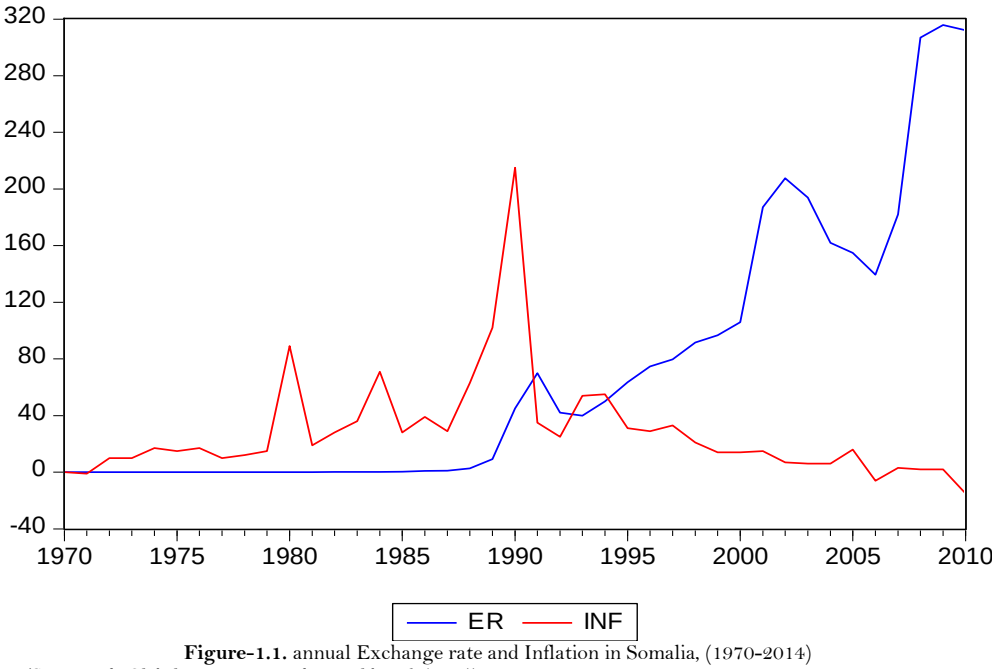


**Figure-1.1.** annual Exchange rate and Inflation in Somalia, (1970-2014)
**(Source:** TheGlobalEconomy.com, the World Bank (2015))

Figure 1.1 explain Somali exchange and inflation has fluctuations in 1970 up to 1990 the exchange in Somalia was stable after 1991 starts to increase rapidly, but the inflation increased1990 but after that was began to decline.

Exchange rate is the price of one currency in terms of another currency and it is important for Somalia to appreciate Somali shilling which leads to raise the value of their product in the international market.

Exchange rate is important for the country as it determines the level of many sectors. If the domestic currency appreciates to a foreign currency, imported goods will be low price in the domestic market, thus local industries would find that their foreign competitor's goods become more attractive to customers. If the country has a strong currency, then its goods become expensive in the international market.

The Somali state has collapsed and many national institutions faded away, but not the foreign exchange rate market. On the contrary, it grew bigger, more efficient and more endowed with resource. The Somali Shilling had suffered from artificial money which cause the depreciation of money and causes inflationary pressure and cause chaotic financial situations according to many observers.

The exchange rate of Somalia has changed in many times the Somali shilling in 1991 was 4,500 and changed 2006 into 13,500 to be the last in 2010 to 31,000 so.sh so that we investigate the fluctuations of the exchange rate. The objective of this paper is to find determinants of the exchange rates in Somalia. This paper specifically examines some important variables of the exchange rate in Somalia. This paper specifically examines some important variables like money supply, external debt, inflation, trade balance, lack of government and GDP per capita. Using time series data of 44 years from 1970 to 2014 to measure the exchange rates determinants.

The results of this paper will benefit central bank of Somalia and policy-makers to get more information about what determines exchange rate in Somalia. The paper helps to get tools that can be controlled the determinant of exchange rate in that will be useful not only to the policy makers and financial instructions but foreign investors as

well. This paper comprised into three parts structured as follows: the next section reviews related literature. Data and Methodology used in this study described in Section 3. Discussion of the results presented in Section 4. Conclusion and policy implication appear in Section 5.

## 2. LITERATURE REVIEW

### 2.1. Exchange Rate and Inflation

Previous literature have explored the relationship between exchange rate and inflation, some researchers found a positive relationship between exchange rate and inflation (Muço *et al*., 2004) and some other researchers found a negative relationship (Arslaner *et al*., 2014).

Muço *et al*. (2004) examined relationship between exchange rate and inflation, this paper seeks to set up the relative between exchange rate and inflation volatility by adopting extra sophisticated econometric methodology than those applied so far, a bivariate GARCH model, commerce directly with the effects of conditional volatilities. They found that a semi-concave relation between exchange rate and inflation variances, in a different way from what was predictable for financial series and in line with the intuition obtained from other studies. They innovate by (i) applying a multivariate GARCH model, then allowing for conditional variance to evaluate the relation between volatilities (ii) trying to launch a relation between exchange rate and inflation volatilities and its insinuation for the monetary policy and (iii) viewing that traditional tests perform with exogenously constructed volatility series are responsive to the criteria chosen to construct such series and do not reveal relevant features of that relation.

Some studies found a negative relationship between exchange rate and inflation, for example, Arslaner *et al*. (2014) regarded to the relationship between the rate of inflation and the exchange rate. And they used correlation coefficients between exchange rates and inflation differentials, vector auto-regression (VAR), single equation regressions and Markaw switching regression methods, the determinants of exchange rate Pass-Through (ERPT) to manufacturer and consumer price are quantitatively analyze between January 1986 and August 2013. The found that ERPT for producer price index-based inflation to be rising than for consumer-prices index based inflation. They also found that the level of ERPT raise as the data increase is agreed on to prices, yet decline in exchange rate. They concluded that even through the inflation has deviated from its embattled stage over the level decade; it is not believable to make an essential change in Turkey's microeconomic political partiality at this stage.

### 2.2. Exchange Rate and External Debt

The past literature views have explained the relationship between Exchange rate and External debt, some authorizes found that a positive relationship between exchange rate and external debt (Saheed, 2015) examined the impact of public external debt on exchange rate in Nigeria. And he used the Ordinary Least Square, on the secondary data sourced from the Central Bank of Nigeria (CBN) and Debt Management Office (DMO) among other source, his findings reveal that all the dependent variables, that is external debt, debt service payment and foreign reserve proved to be statistically significant in explanation exchange rate fluctuation in Nigeria with in the period observation, with debt service payment having the strongest effect. He recommends that government should guarantee that all public borrowing, where and when required be directed towards productive economic activities which can engender returns to service and pay the debt at maturity.

Other studies found negative relationship between exchange rate and external debt, for example (Awan *et al*., 2011) examined the relationship impact of exchange rate, terms of trade fiscal deficit on external debt of Pakistan. They used Johansen approach to evaluate the relationship between external debt and exchange rate, fiscal deficit and worsening of terms of trade for the period 1974-2008. They found considerable long-run relationship between external debt and exchange rate and deterioration of terms of trade. Their results of the study discovered that fiscal deficit had no significant impact on external debt. In the short-run all the variables failed to establish relationship with external debt. So that, being of long-run causality was observed and three channels of uni- directional

causalities were found actively in succession from (1) fiscal deficit to external debt, (2) terms of trade to exchange rate, and (3) fiscal deficit to terms of trade. They suggest that support of transparency; accountability and mitigation of rising trend of corruption are necessary in order to make sure good governance which is crucial for accelerating economic growth through the efficient and proper use of external resource. Also, continued efforts on economic growth, social and institutional fronts are required to remove all the bottlenecks that have resulted in high growth of foreign debt in Pakistan

### 2.3. Exchange Rate and Trade Balance

The following researchers investigates the relationship between exchange rate and trade balance.

Scholars have studied the positive relationship between exchange rate and trade balance, for instance (Petrović and Mirjana, 2010) on the other hand some other researchers had found a negative relationship in exchange rate and trade balance like (Kharroubi, 2011).

Petrović and Mirjana (2010) examined the exchange rate depreciation in Serbia. This study was used Both Johansen's and autoregressive dispersed lag approach are in that order used giving similar long-run estimates viewing that real depreciation improves trade balance.

The main findings of this study are that exchanger ate depreciation has a significant positive long run impact on the trade balance in Serbia, and that in the short run trade balance first deteriorates. Before it later improves. The paper was concluded that domestic output growth (GDP) leads to an improvement of the trade balance. This implies that output growth boosts export.

Yet, other studies found a negative relationship between exchange rate and trade balance, Kharroubi (2011) examined the relationship between the trade balance and the real exchange rate into two behaviors. On the one side, the growth of trade enchanting place within industries makes the trade balance more sensitive to real exchange rate movements, on the other side a higher degree of vertical specialization and more global supply chains act to decrease this sensitivity. The relative importance of these two effects varies across countries. According to the estimate presented in this study, changes in the real exchange rate could play a bigger role in reduction the US trade deficit than in decreasing the Chinese trade surplus. The study was concluded for to confirm real exchange rate modification is only part of the explanation for global rebalancing and needs to be accompanied by other policy actions.

### 2.4. Exchange Rate and Lack of Government

Faia *et al.* (2008) studied the political economy of exchange rate stability in emerging market economies. And they used common agency approach with rational expectations. They found that political pressure affect exchange rate policy and it create an over-commitment to exchange rate stability. Their model suggested that the effect of political pressures on the exchange rate is reduced if the quality of institution is high (Eichengreen, 2008) for instance document the refusal of the Federal Reserve to dump the Gold Exchange standard system and linkage this to the political pressure of lobbies on behalf of the banking sector.

### 2.5. Exchange Rate and Money Supply

Bhattarai (2011) examined the impact of exchange rate and money supply on growth, inflation and interest rates in the UK. The study used cross-section data by applying ILS, 2SLS and 3SLS techniques to show simultaneity among growth rates, inflation, interest rate and exchange rates in the UK. They found that interest rates have been persistent and contractionary and money has been non-neutral in the short run. According to these estimates, the higher the liquidity in the financial system the higher is the interest rates. This indicates the role of London as a financial hub in the global economy, inflation, driven up by growth rate if money as well as the depreciation of pounds and higher interest rates, has adversely affected the growth rate of output. The concluded

that depreciation of sterling contributed to growth of output in UK by enhancing the international competitiveness and has the higher rate of growth of money supply.

Levin (1997) investigates to re-examine the issue of exchange rate dynamics when the central bank undertakes a change in growth rate of the money supply, using panel data for central bank by applying the Dornbusch model to analyze the problem using a variable output version. The study found that money supply growth causes the exchange rate to either overshoot or undershoot. In addition, the real exchange rate depends inversely on the real interest rate during part of the adjustment process, in contrast to the real interest differential model. He considers an overall evaluation of the model. It seems reasonable to believe that inflation will gradually respond to monetary growth and that initially interest rates will decline after a monetary growth shock. In addition, a variable output model is a plausible description of the economy; therefore, the behavior of the exchange rate and other variables in the model appears to be a sensible characterization of the system.

### 2.6. GDP Per Capita and Exchange Rate

Khan (2010) tests the relationship between per capita income differential and exchange rate differential between two different economic background countries. The study had chosen United State of America as fully developed country and Pakistan as developing country. The study was conducted during the past ten-year per capita income and exchange rate data in rupees. The finding of this research suggested that a positive relationship between per capita income differential and exchange rate differential but there is a small impact of per capita income differential on exchange rate between these two countries as there is an enormous difference between the USA per capita income and Pakistan per capita income, Pakistan always has a massive per capita income because of that reason Pakistan currency continuously depreciating.

Haddad and Pancaro (2010) examined the policy of managed real undervaluation may have been a main factor behind the success of East Asia's export-led growth model. The current discussions over the worth of chine's currency exhibit the controversy, this kind of policy can generate. Although a managed real undervaluation can improve domestic competitiveness, it is difficult to sustain both economically and politically in the post-crisis environment. The results show that re-undervaluation works only for low-income countries, and only in the medium term. The main finding is based on estimates the relationship between real exchange rate volatility calculated as the standard deviation of and average real GDP per capita growth in a panel of countries with GDP per capita incomes lesser than $6,000 between 1980 and 2004.

Previous researchers have empirically estimated these fundamentals models, but only selecting variables that suit their different situation. So, the paper will include some variables which other researchers have not used in analyzing the determinants of exchange rate, such as external debt, lack of government as dummy variable. These gaps that have already been mentioned will be addressed in this study.

## 3. DATA AND METHODOLOGY

### 3.1. Monetary Approach

The exchange theory synthesizes many recent and older contributions to the theory of exchange rate determination. Since the task of exchange rate theory is to explain behavior observed in the real world, there are many theories like purchasing power parity, monetary approach, and quantity theory of money and Balance of payment. In this study, we consider monetary approach.

The monetary approach happens to be one of the oldest approaches to determine the exchange rate. It's furthermore utilized as a measure to compare the other approaches to determine exchange rate. Monetary approach was originally developed by Frenkel (1976); Mussa (1979) and Bilson (1979). And the basic factors of monetary approach are exchange rate, money supply, real income or (industrial production), interest rate, inflation and trade balances.

In case of this study, Somalia faced civil wars in 1991 in which the main industries have collapsed, so that in the absence of industries, the study will change industrial production factor with the other factor that is important according to Somalia, like GDP per capita which are similar to real income or industrial production. And this study will not consider interest rate as explanatory variable because Somali financial institution did not practice interest rate at all.

### 3.2. Data Source

In our empirical analysis, we used time series data from 1970 to 2014 in Somalia, we obtained data from different sources such as World Bank, SESRIC, and Trading Economics and it is balanced data.

### 3.3. Model Specification

We employ ordinary least squares (OLS) regression to estimate exchange rate in Somalia. This article follows monetary approach model to exchange rate which is:

$$E = \beta_0 + \beta_1 INF + \beta_2 EXD + \beta_3 MS + \beta_4 BOT + \beta_5 GDPP + \alpha LG + \varepsilon_t$$

Where E stands exchange rate, INF is Inflation, EXD is external debt, MS is Money Supply, BOT is balance of Trade, GDPP is gross domestic product per capita, LG is lac of government and $\varepsilon_t$ is error term.

This study first examines unit root test by using the Augmented-Dickey-Fuller (ADF). And measure how OLS regression fits to the data line. This paper assume that total sum square is not equal to Zero which is true unless all dependent variable has equal value.

## 4. RESULTS AND DISCUSSIONS

### 4.1. Descriptive Statistics

Table-1.1 present Descriptive analysis which show that the maximum, minimum and mean average. Mean value stands highest average and standard deviation.

**Table-4.1.** summary statistics of the variables

| | Exchange rate | Trade balance | External debt | GDP per capita | Inflation | Lack of government | Money supply |
|---|---|---|---|---|---|---|---|
| Mean | 8566.704 | -52819778 | 1933000. | 163.6953 | 63.90410 | 1.511111 | 188000000000 |
| Median | 4500.000 | -28100000 | 2449385. | 151.0900 | 34.44000 | 2.000000 | 110000000000 |
| Maximum | 31585.42 | -14670000 | 3055515. | 284.7000 | 215.4668 | 2.000000 | 534000000000 |
| Minimum | 6.281500 | -195000000 | 77085.00 | 89.94000 | 0.688919 | 1.000000 | 390000000 |
| Std. Dev. | 10200.80 | 44246756 | 1064979. | 61.66477 | 58.62033 | 0.505525 | 204000000000 |
| Skewness | 0.942756 | -1.215520 | -0.667114 | 0.721975 | 1.087947 | -0.044455 | 0.592835 |
| Kurtosis | 2.655066 | 3.776476 | 1.866358 | 2.308620 | 2.993317 | 1.001976 | 1.610420 |
| Jarque-Bera | 6.889005 | 12.21164 | 5.747456 | 4.805627 | 8.877297 | 7.500007 | 6.256401 |
| Probability | 0.031921 | 0.002230 | 0.056488 | 0.090463 | 0.011812 | 0.023518 | 0.043797 |

**Source:** Author`s calculations using data from the world bank, SESRIC and trading economics

Table 4.1 descriptive results shows the dependent and independent variables. Result indicates that average of dependent variable of exchange rate is (8566.704) unit, and its standard deviation is (10200.80) and the highest is (31585.42) unit. With the independent variables include trade balance, external debt, lack of government, money supply, GDP per capita and inflation. The average of external debt is (1933000) unit, and its standard deviation is (1064979) and the highest is (3055515) unit. The average of trade balance is (-52819778) unit and its standard deviation is (44246756) and its highest is (-14670000) unit. The average of money supply is (1.88E+11) unit. And

its standard deviation is (2.04E+11) and its highest is (5.34E+11) unit average of LG is (1.511111) and its standard deviation is 0.505525) and its highest is (2.000000). The mean average of GDP per capita is (163.6953), the standard deviation of GDP per capita is (61.66477), and its highest is (284.7000). The mean average of inflation is (63.90410), the standard deviation of inflation is (58.62033), and its highest is (215.4668),

Money supply has the highest average number which is (188000000000) while trade balance has the lowest average number which is (-52819778). Highest Standard deviation variable is money supply (204000000000). And lack of government has the lowest Standard deviation (0.505525).

### 4.2. Unit Root Test

The result shows that the null hypothesis of non-stationary at level for all the times series fails to be accepted. However, all null hypotheses were rejected for every test at first difference. It indicates clear that all variables are stationary at (first difference). At first, the study have to test all variables with unit root to determine whether stationary or not. The ADF (augmented Dickey- Fulller) and Philippe-Perron test is used check the stationary of the all variables for the whole period.

**Table-4.2.** Unit root Test (stationary test at level & at 1st difference)

| Variables | ADF | | PP | |
|---|---|---|---|---|
| | At level | 1st difference | At level | 1st difference |
| LER | -0.994215 | -4.248494 | -1.170430 | -3.563979 |
| LEXD | -2.312503 | -4.901804 | -2.191159 | -4.910218 |
| LBOT | -3.242506 | -4.950366 | -2.919401 | -4.950366 |
| LMS | -0.303982 | -6.934966 | -0.258311 | -6.934983 |
| LG | -1.975637 | -6.477477 | -2.026513 | -6.477427 |
| LINF | -4.814376 | -8.518153 | -4.830323 | -9.330194 |
| LGDPP | -3.112926 | -5.292192 | -2.562945 | -5.701303 |

**Source:** Author1s calculations using data from the World Bank, SESRIC and trading economics.

### 4.3. Estimation of the Model Parameters

After checking the stationary of the time series variable and having established the presence of a unit root in the first difference of each variable, the next step we estimated our model coefficients to test where the is relationship between variables or not.

**Table-4.3.** Estimation of the Model Coefficients (log first difference).

| Variable | Coefficient | Std. Error | t-statics | Prob. |
|---|---|---|---|---|
| DLEXD | -2.141951 | 0.695270 | -3.080748 | 0.0039 |
| DLBOT | -0.198076 | 0.087638 | -2.260153 | 0.0298 |
| LG | 0.719360 | 0.165758 | 4.339807 | 0.0001 |
| DLMS | -0.420747 | 0.200124 | -2.102428 | 0.0424 |
| DLINF | -0.107269 | 0.091012 | -1.178624 | 0.2461 |
| DLGDPP | 0.241010 | 0.281036 | 0.857577 | 0.3966 |
| C | -1.529609 | 0.317298 | -4.820729 | 0.0000 |

**Source:** Author`s calculations using data from world bank, SESRIC and trading economics

The result of the model shows that the coefficients of DLEXD (-2.141951), DLBOT(-0.198076), DLMS (-0.420747) and DLINF (-0.107269) have negative relationship with exchange rate and this means that one increase (decrease) in each one of these variable will result in one percent increase (decrease) in the exchange rate while holding other variables constant. The model also shows that LG (0.719360), DLGDPP (0.241010) have positive relationship with Exchange rate.

Furthermore, the average trade balance is inversely related to exchange rates whereby an increase trade balance decrease the exchange rates in Somalia, Because the import in Somalia exceeds the export which leads deficit in trade balance, thus cause to increase the exchange rate in Somalia.

Money supply has an inverse relationship with the exchange rates in Somalia whereby an increase money supply decreases the exchange rates in Somalia. Because the supply of money is controlled and printed by private sectors that mainly causes to exchange rate being uncontrollable.

External debt has an inverse relationship with the exchange rates in Somalia. Thus, the external debt causes to receive foreign currency in the country which appreciates the Somalia Shilling and this promotes import of good from outside and will probably contribute to higher unemployment.

As the results indicates, lack of government is directly related to rates exchange rate of Somali shillings against other foreign currencies, because the lack of government which means losing the control of domestic currency and the role of the government toward the Somali shillings which in turn causes to depreciate the exchange rate.

The results of diagnostic test show that there is neither Heteroskedasticity nor serial correlation exist which means the model of choosing is best fit. The validity of the model tested with comparing $R^2$ with Durbin- Watson test, in general if DW is greater that $R^2$ model is valid otherwise not. Since DW= 2.305279 is greater than $R^2$ = 45% and F-statistic are significant, this modal has validity.

From the below, there is no serial correlation in the model because the probability of the Prob. Chi-Square (4) (0.0982) by 3Lags is greater than 0.05 on the other hand, there is no heteroskedasticity in the model owing to the fact that the probability of the Prob. Chi-Square (0.0942) by 2 Lags and greater than 0.05 and all independent variable are insignificant and there is normal distribution because the probability is less than 0.5 (0.001597).

**Table-4.4.** Multicollinearity (Correlation Matrix)

| | **Exchange rate** | **Trade balance** | **Externa l debt** | **GDP per capita** | **Inflatio n** | **Lack of government** | **Mone y supply** |
|---|---|---|---|---|---|---|---|
| ER | 1 | | | | | | |
| BOT | 0.57 | 1 | | | | | |
| EXD | 0.75 | 0.49 | 1 | | | | |
| GDPP | 0.38 | 0.22 | 0.48 | 1 | | | |
| INF | 0.72 | 0.28 | 0.61 | 0.25 | 1 | | |
| LG | 0.78 | 0.71 | 0.82 | 0.57 | 0.41 | 1 | |
| MS | 0.90 | 0.55 | 0.77 | 0.49 | 0.64 | 0.80 | 1 |

**Source:** Author`s calculations using Data from the World Bank, SESRIC and trading economics

**Table-4.5.** Heteroscedasticity Test

| **Heteroskedasticity Test: ARCH** | | | |
|---|---|---|---|
| **F-statistic** | **2.471113** | **Prob. F(2,39)** | **0.0976** |
| Obs*R-squared | 4.723781 | Prob. Chi-Square(2) | 0.0982 |

**Source:** Author`s calculations from world Bank, SESRIC and trading economics

**Table-4.6.** seral correlation

| Breusch-Godfrey serial Correlation LM tests: | | | |
|---|---|---|---|
| F-statistic | 1.784827 | Prob.F(4,33) | 0.1554 |
| Obs*R-Square | 7.825984 | Prob. Chi-Square (4) | 0.0982 |

**Source:** Author`s calculation using data from the World Bank, SESRIC and trading economics

## 5. CONCLUSION AND POLICY IMPLICATION

The study examined exchange rate in Somalia and mainly we focused on these explanatory variables such as trade balance, money supply, external debt and lack of government. I tested exchange rate of Somali from 1970 to 2014. The OLS estimates showed that some of the variables have strong and consistent evidence that trade balance and external debt have negative impact on exchange rate. Our findings seem to support Kharroubi (2011) and Awan *et al.* (2011). An import finding of this study is that lack of government has great impact on exchange rate in Somalia. Perhaps, Somali is lack of strong central government since 1991. Thus, this have positively effect on exchange rate in Somalia.

The finding from this study have important policy implications, the empirical evidence suggests that central bank of Somalia should play important role to control printing money that increases supply of money in such a way that the inflation is prevented from rising without affecting investment and production adversely.

On the other hand, the effect of other explanatory variable on exchange rate such as inflation and GDP has no significant effect on exchange rate. The study suggests that in order to achieve positive trade balance, central bank should stabilize the exchange rate in Somalia.

We hope that this study will encourage additional empirical analysis on estimating the exchange rate via other variables. It would be interesting to find the relationship between exchange rate change and output performance in Somalia. Therefore, our findings need further analysis by adding output performance and updated data in Somalia.

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**Contributors/Acknowledgement:** Both authors contributed equally to the conception and design of the study.

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## APPENDIX

**Descriptive statistics**

| | ER | BOT | EXD | INF | GDPP | LG | MS |
|---|---|---|---|---|---|---|---|
| Mean | 8566.704 | -52819778 | 1933000. | 63.90410 | 163.6953 | 1.511111 | 188000000000 |
| Median | 4500.000 | -28100000 | 2449385. | 34.44000 | 151.0900 | 2.000000 | 110000000000 |
| Maximum | 31585.42 | -14670000 | 3055515. | 215.4668 | 284.7000 | 2.000000 | 534000000000 |
| Minimum | 6.281500 | -195000000 | 77085.00 | 0.688919 | 89.94000 | 1.000000 | 390000000 |
| Std. Dev. | 10200.80 | 44246756 | 1064979. | 58.62033 | 61.66477 | 0.505525 | 204000000000 |
| Skewness | 0.942756 | -1.215520 | -0.667114 | 1.087947 | 0.721975 | -0.044455 | 0.592835 |
| Kurtosis | 2.655066 | 3.776476 | 1.866358 | 2.993317 | 2.308620 | 1.001976 | 1.610420 |
| Jarque-Bera | 6.889005 | 12.21164 | 5.747456 | 8.877297 | 4.805627 | 7.500007 | 6.256401 |
| Probability | 0.031921 | 0.002230 | 0.056488 | 0.011812 | 0.090463 | 0.023518 | 0.043797 |
| Sum | 385501.7 | -2380000000 | 86985017 | 2875.685 | 7366.290 | 68.00000 | 8480000000000 |
| Sum Sq. Dev. | 4580000000 | 861000000000000000 | 4990000000000000 | 151199.1 | 167311.9 | 11.24444 | 1.848824 |
| Observations | 45 | 45 | 45 | 45 | 45 | 45 | 45 |

**Multicollinearity test**

| Variance Inflation Factors | | | |
|---|---|---|---|
| Date: 08/19/16 Time: 15:35 | | | |
| Sample: 1970 2014 | | | |
| Included observations: 44 | | | |
| | Coefficient | Uncentered | Centered |
| Variable | Variance | VIF | VIF |
| DLBOT | 0.007680 | 1.425123 | 1.425108 |
| DLEXD | 0.483400 | 3.374536 | 2.191956 |
| DLGDPP | 0.078981 | 1.506149 | 1.505019 |
| DLINF | 0.008283 | 1.282706 | 1.240203 |
| LG | 0.027476 | 25.30275 | 2.458011 |
| DLMS | 0.040050 | 1.584681 | 1.244477 |
| C | 0.100678 | 36.10157 | NA |

**Serial correlation test**

| Breusch-Godfrey Serial Correlation LM Test: | | | | |
|---|---|---|---|---|
| F-statistic | 1.784827 | Prob. F(4,33) | | 0.1554 |
| Obs*R-squared | 7.825984 | Prob. Chi-Square(4) | | 0.0982 |
| Test Equation: | | | | |
| Dependent Variable: RESID | | | | |
| Method: Least Squares | | | | |
| Date: 08/19/16 Time: 15:38 | | | | |
| Sample: 1971 2014 | | | | |
| Included observations: 44 | | | | |
| Presample missing value lagged residuals set to zero. | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| DLBOT | 0.004483 | 0.089798 | 0.049920 | 0.9605 |
| DLEXD | 0.400236 | 0.748045 | 0.535043 | 0.5962 |
| DLGDPP | 0.020882 | 0.282890 | 0.073815 | 0.9416 |
| DLINF | 0.062598 | 0.093261 | 0.671213 | 0.5068 |
| LG | -0.137248 | 0.171465 | -0.800442 | 0.4292 |
| DLMS | 0.176546 | 0.205341 | 0.859769 | 0.3961 |
| C | 0.276868 | 0.332321 | 0.833134 | 0.4108 |
| RESID(-1) | 0.440132 | 0.201294 | 2.186506 | 0.0360 |
| RESID(-2) | -0.340326 | 0.203208 | -1.674766 | 0.1034 |
| RESID(-3) | 0.073660 | 0.192321 | 0.383007 | 0.7042 |
| RESID(-4) | 0.018683 | 0.185178 | 0.100895 | 0.9202 |
| R-squared | 0.177863 | Mean dependent var | | 1.03E-16 |
| Adjusted R-squared | -0.071269 | S.D. dependent var | | 0.324936 |
| S.E. of regression | 0.336316 | Akaike info criterion | | 0.870784 |
| Sum squared resid | 3.732569 | Schwarz criterion | | 1.316831 |
| Log likelihood | -8.157249 | Hannan-Quinn criter. | | 1.036200 |
| F-statistic | 0.713931 | Durbin-Watson stat | | 2.082441 |
| Prob(F-statistic) | 0.705255 | | | |

**Heteroskedasticity test**

| Heteroskedasticity Test: ARCH | | | | |
|---|---|---|---|---|
| F-statistic | 2.471113 | Prob. F(2,39) | | 0.0976 |
| Obs*R-squared | 4.723781 | Prob. Chi-Square(2) | | 0.0942 |
| Test Equation: | | | | |
| Dependent Variable: RESID^2 | | | | |
| Method: Least Squares | | | | |
| Date: 08/19/16 Time: 15:41 | | | | |
| Sample (adjusted): 1973 2014 | | | | |
| Included observations: 42 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 0.069420 | 0.036667 | 1.893277 | 0.0658 |
| RESID^2(-1) | 0.344151 | 0.159836 | 2.153146 | 0.0376 |
| RESID^2(-2) | -0.029106 | 0.159223 | -0.182803 | 0.8559 |
| R-squared | 0.112471 | Mean dependent var | | 0.101483 |
| Adjusted R-squared | 0.066957 | S.D. dependent var | | 0.209302 |
| S.E. of regression | 0.202173 | Akaike info criterion | | -0.290634 |
| Sum squared resid | 1.594087 | Schwarz criterion | | -0.166515 |
| Log likelihood | 9.103324 | Hannan-Quinn criter. | | -0.245140 |
| F-statistic | 2.471113 | Durbin-Watson stat | | 2.007987 |
| Prob(F-statistic) | 0.097625 | | | |

**Data Table**

| years | DLER | DLEXD | DLMS | LG | DLINF | DLBOT | DLGDPP |
|---|---|---|---|---|---|---|---|
| 1970 | | | | 1 | | | |
| 1971 | 0.002004 | -0.09087 | 0.186586 | 1 | -0.98444 | -0.57453 | -0.00815 |
| 1972 | 0.021042 | -0.18047 | -0.28768 | 1 | -1.87228 | 0.187528 | -0.25146 |
| 1973 | 0.105458 | -0.20538 | -0.15963 | 1 | 0.031937 | -2.37469 | -0.06662 |
| 1974 | -0.00215 | -0.34193 | -0.24583 | 1 | -0.11827 | -0.94242 | -0.13561 |
| 1975 | 0 | -0.27026 | -0.25841 | 1 | -0.25562 | 0.048874 | -0.21655 |
| 1976 | 0 | -0.25088 | -0.17237 | 1 | 0.136072 | -0.16607 | -0.04755 |
| 1977 | 0 | -0.30872 | -0.24946 | 1 | 0.408133 | 0.856483 | 0.782258 |
| 1978 | 0 | -0.27178 | -0.28606 | 1 | -0.40169 | 0.350818 | -0.01759 |
| 1979 | 0 | -0.09236 | -0.31534 | 1 | 0.114867 | -1.0087 | 0.057047 |
| 1980 | 0 | -0.13434 | -0.18469 | 1 | -2.04549 | 0.909809 | -0.04829 |
| 1981 | 0 | -0.47023 | -0.26826 | 1 | 1.612148 | 0.36539 | -0.1238 |
| 1982 | -0.53518 | -0.14587 | -0.14701 | 1 | -0.28753 | -0.8265 | -0.08433 |
| 1983 | -0.38429 | -0.14351 | -0.07159 | 1 | -0.17636 | -0.31692 | 0.072792 |
| 1984 | -0.23743 | -0.06037 | -0.23111 | 1 | -0.80618 | 0.510456 | -0.08102 |
| 1985 | -0.67932 | -0.09014 | -0.59466 | 1 | 0.884002 | -0.5354 | -0.12986 |
| 1986 | -0.60069 | -0.09336 | -0.29265 | 1 | -0.12427 | -0.50589 | 0.004055 |
| 1987 | -0.37898 | -0.11012 | -0.82046 | 1 | 0.026355 | -0.75222 | -0.11213 |
| 1988 | -0.48281 | -0.03754 | -0.45256 | 1 | -0.76032 | 0.636395 | -0.01615 |
| 1989 | -1.05732 | -0.03447 | -0.96636 | 1 | -0.33268 | 1.027999 | -0.02548 |
| 1990 | -2.21605 | -0.09325 | 0.804086 | 1 | -0.79381 | 1.113529 | -0.01448 |
| 1991 | -0.44183 | -0.03283 | -0.44476 | 1 | 1.90084 | 1.966184 | 0.481581 |
| 1992 | 0.510826 | 0.001136 | -0.19687 | 2 | -0.06725 | 0.103685 | 0.047211 |
| 1993 | 0.04879 | -0.02181 | 0.078183 | 2 | -0.03341 | -0.21165 | -0.53948 |
| 1994 | -0.22314 | -0.0452 | 0.084818 | 2 | 0.052758 | 0.464056 | -0.12098 |
| 1995 | -0.24064 | -0.02353 | 0.092684 | 2 | -0.07799 | 0.006572 | 0.014318 |
| 1996 | -0.16134 | 0.01326 | -0.19506 | 2 | 0.427754 | -0.23337 | -0.09499 |
| 1997 | -0.06456 | 0.031449 | 0.083278 | 2 | -0.20098 | -0.3248 | -0.13295 |
| 1998 | -0.13849 | -0.02837 | 0.090849 | 2 | -0.06452 | -0.59593 | -0.22794 |
| 1999 | -0.05471 | 0.003907 | -0.70112 | 2 | 0.019513 | 0.047131 | 0.046032 |
| 2000 | -0.09173 | 0.017447 | -0.44619 | 2 | -0.20049 | -0.1233 | -0.04204 |
| 2001 | -0.56852 | -0.00026 | -0.46851 | 2 | -0.18272 | 0.908653 | 0.484424 |
| 2002 | -0.10342 | -0.04822 | 0.019081 | 2 | -0.14325 | 0.132069 | 0.094341 |
| 2003 | 0.067673 | -0.05421 | 0.019452 | 2 | -0.16339 | -0.39633 | -0.19168 |
| 2004 | 0.180378 | -0.00406 | 0.019838 | 2 | -0.22136 | -0.53468 | -0.24276 |
| 2005 | 0.044111 | 0.035439 | 0.020239 | 2 | -0.27786 | -0.36527 | -0.12847 |
| 2006 | 0.10524 | -0.031 | 0.020657 | 2 | -0.25193 | -0.06168 | -0.00602 |
| 2007 | -0.26608 | -0.03711 | 0.021093 | 2 | -0.27251 | -0.06042 | -0.01293 |
| 2008 | -0.52259 | -0.00154 | 0.021548 | 2 | -0.0733 | -0.10782 | -0.02126 |
| 2009 | -0.02857 | -0.02519 | 0.022022 | 2 | 0.054599 | 0.517038 | 0.280798 |
| 2010 | 0.011714 | 4.73E-05 | 0.022518 | 2 | -0.14001 | 1.26428 | 0.653926 |
| 2011 | 0.039015 | -0.00256 | 0.004067 | 2 | 0.391598 | 0.004086 | 0.026925 |
| 2012 | 0.275758 | -0.00044 | 0.01897 | 2 | 0.030417 | -0.40357 | -0.1789 |
| 2013 | 0.170986 | -0.00029 | 0.016283 | 2 | -0.03295 | -0.13568 | -0.04558 |
| 2014 | -0.05697 | 0.045508 | 0.038246 | 2 | 0.008457 | 0.033597 | 0.041367 |